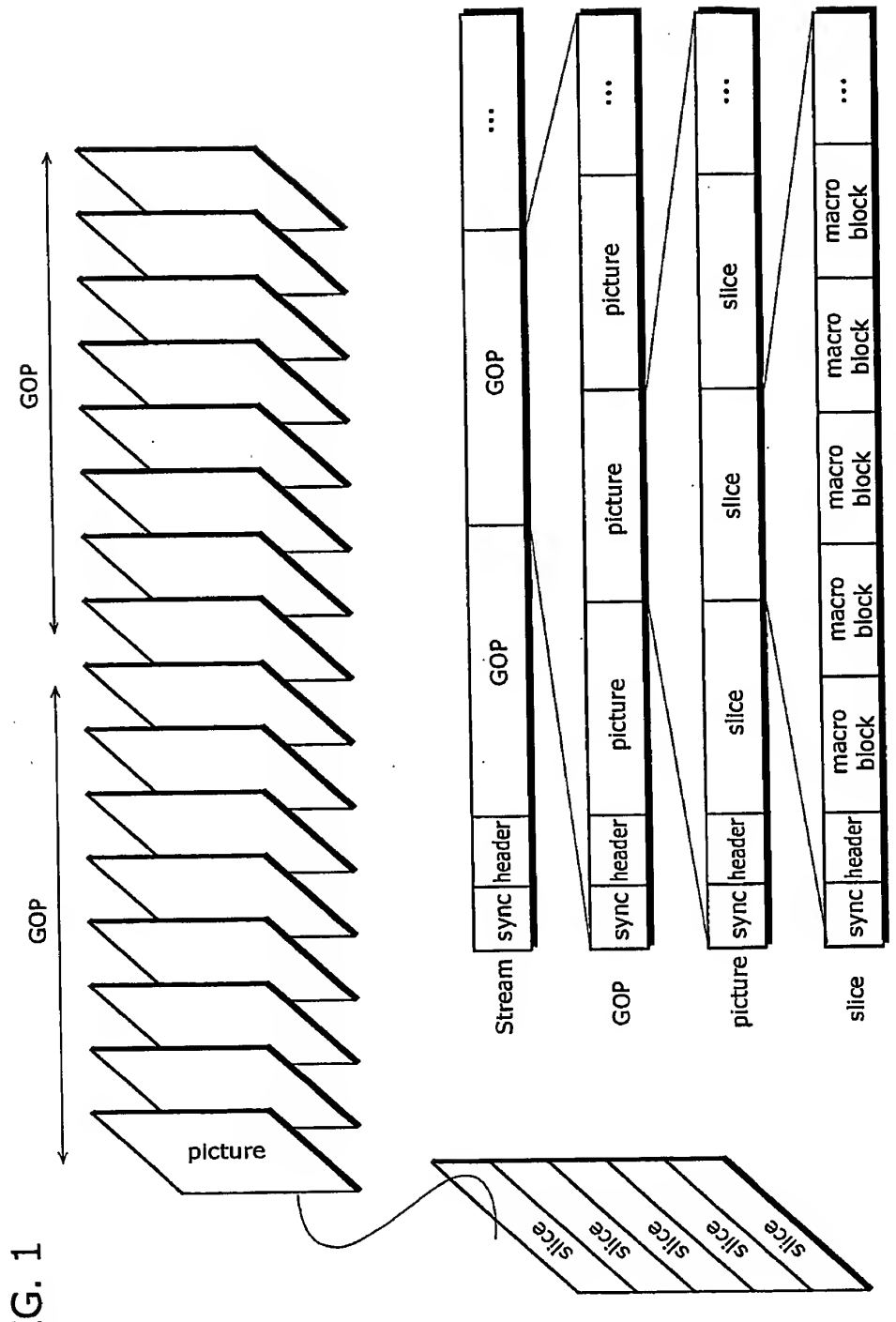
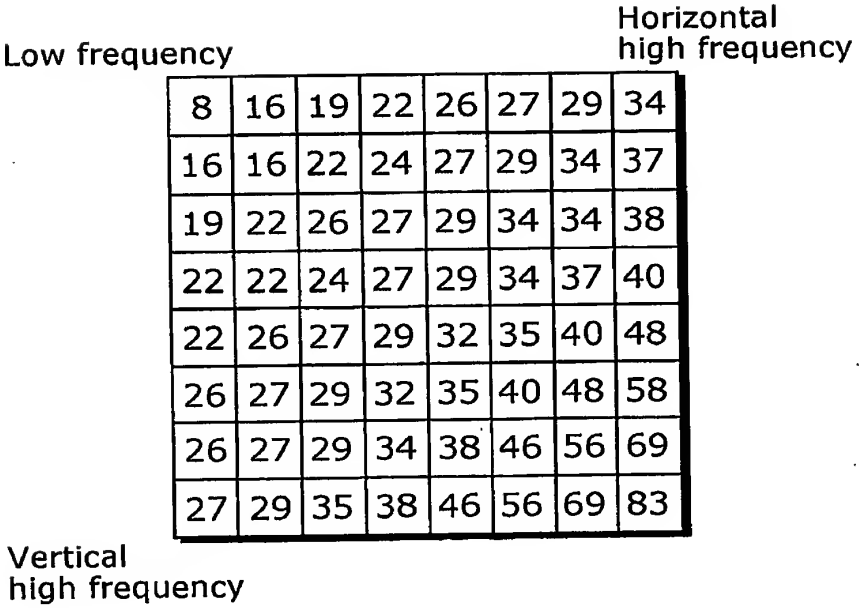

GOP
GOP
picture
slice
slice
slice
slice
slice
slice
Stream
GOP
picture
slice
sync
header
macro block
...

FIG. 1

FIG. 2



8	16	19	22	26	27	29	34
16	16	22	24	27	29	34	37
19	22	26	27	29	34	34	38
22	22	24	27	29	34	37	40
22	26	27	29	32	35	40	48
26	27	29	32	35	40	48	58
26	27	29	34	38	46	56	69
27	29	35	38	46	56	69	83

FIG. 3

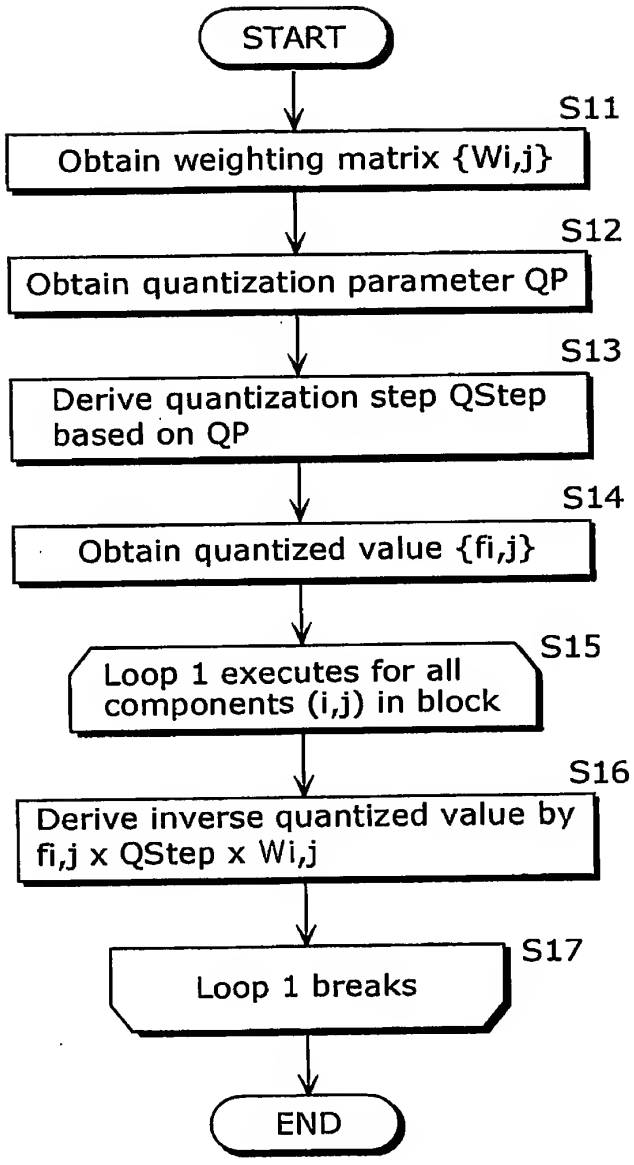

START
S11
Obtain weighting matrix {Wi,j}
S12
Obtain quantization parameter QP
S13
Derive quantization step QStep based on QP
S14
Obtain quantized value {fi,j}
S15
Loop 1 executes for all components (i,j) in block
S16
Derive inverse quantized value by fi,j x QStep x Wi,j
S17
Loop 1 breaks
END

FIG. 4

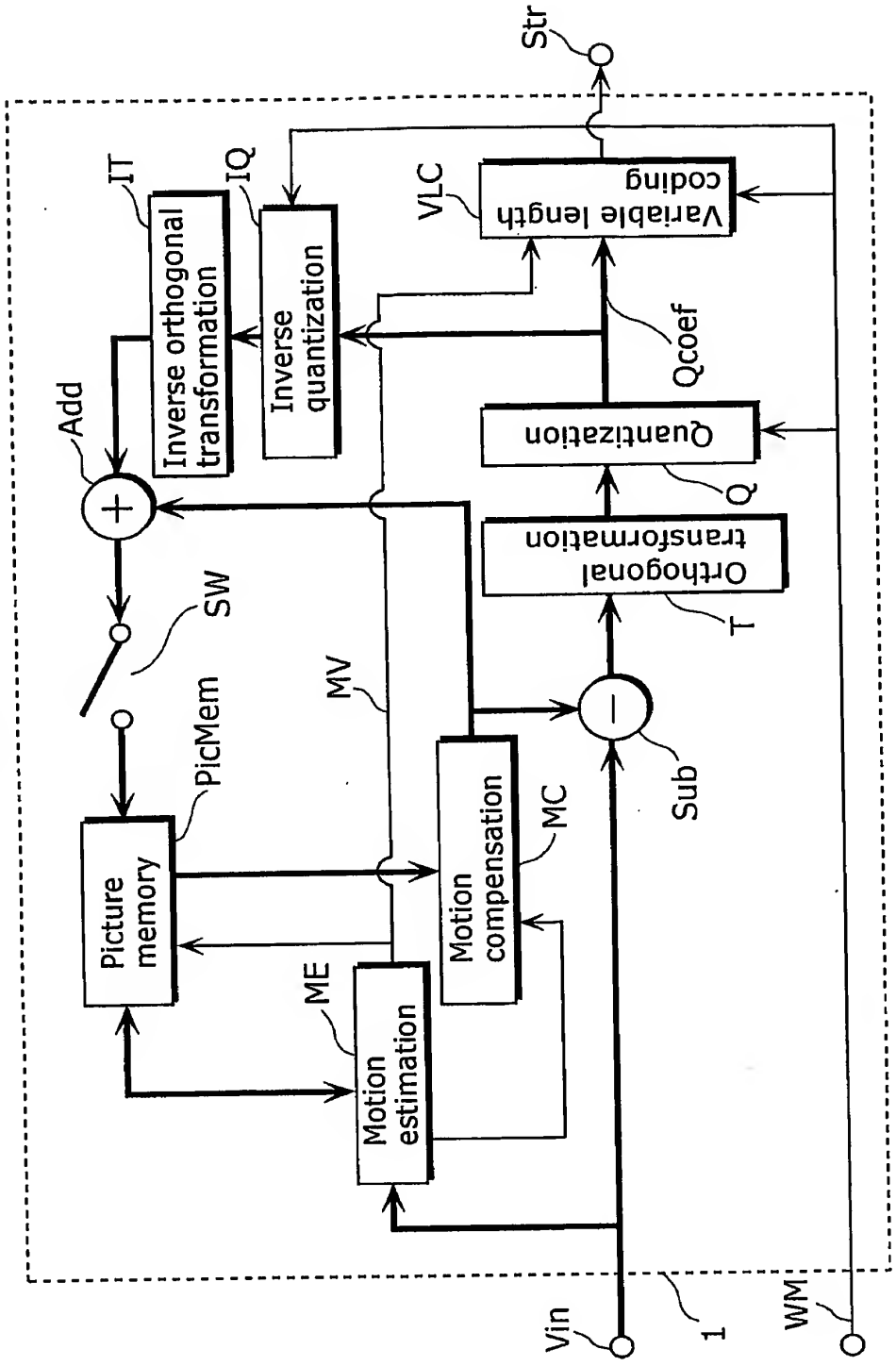

Str
IT
IQ
VLC
Inverse orthogonal transformation
Inverse quantization
Variable length coding
Add
Qcoef
Quantization
Q
Orthogonal transformation
T
SW
MV
PicMem
Sub
Picture memory
Motion compensation
MC
ME
Motion estimation
Vin
1
WM

FIG. 5

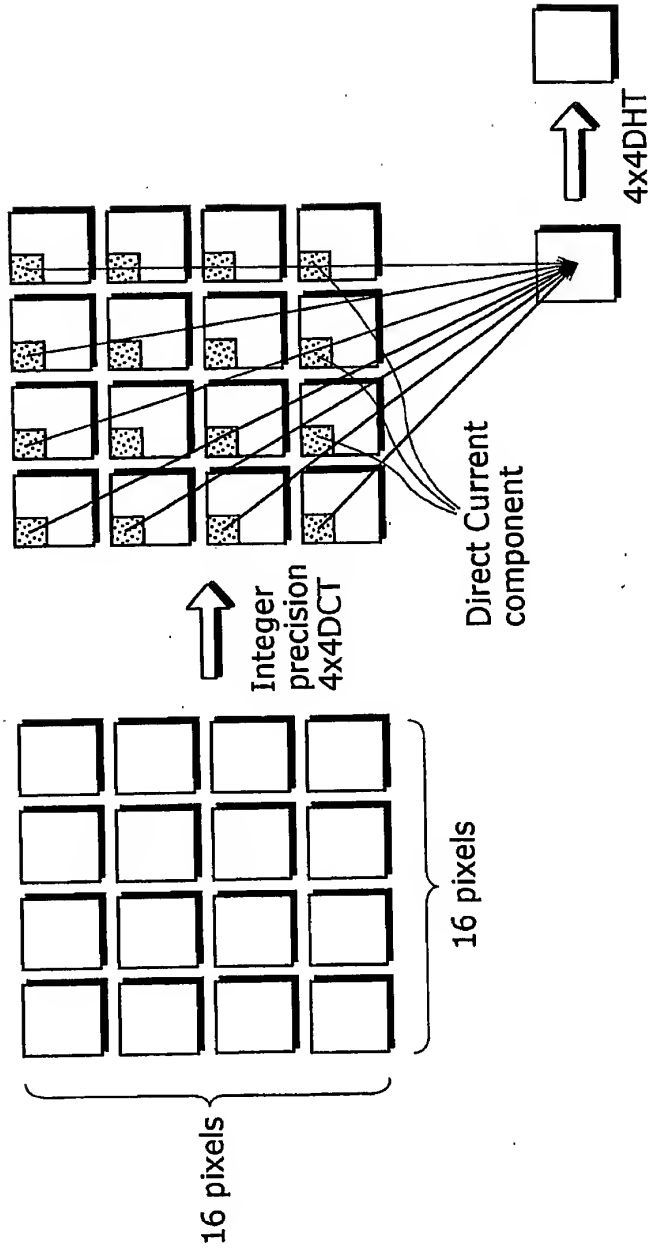
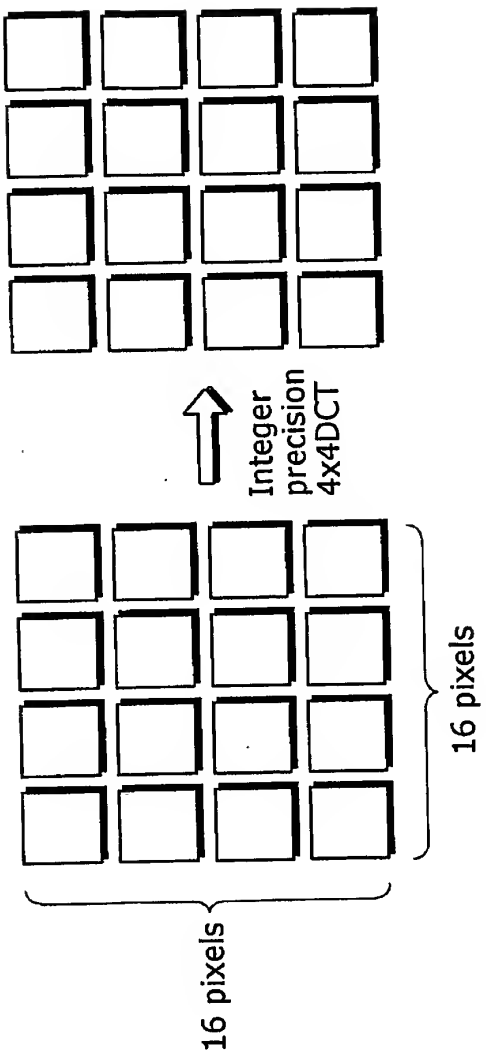

16 pixels
16 pixels
Integer precision 4x4DCT
Direct Current component
4x4DHT

FIG. 6



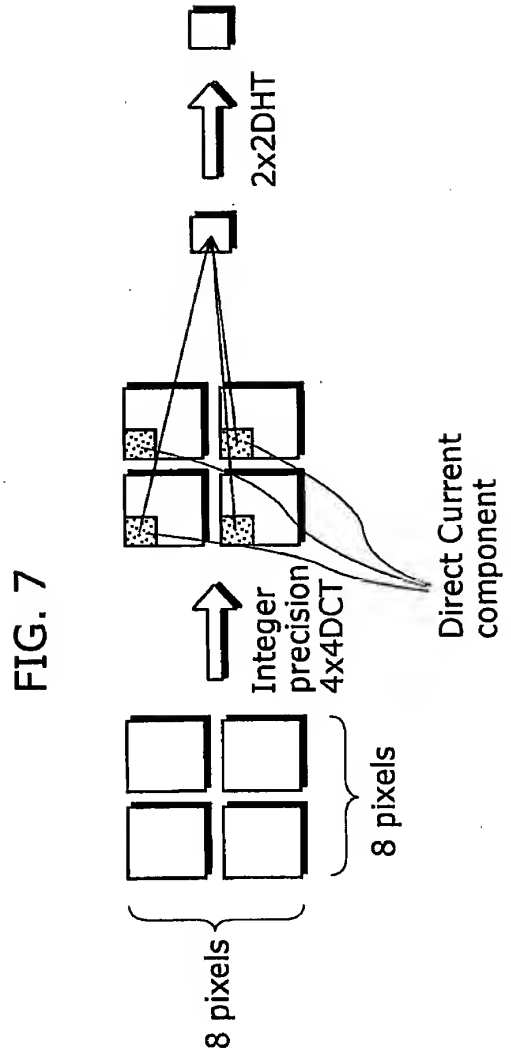

8 pixels
8 pixels
Integer precision 4x4DCT
Direct Current component
2x2DHT

FIG. 7

FIG. 8

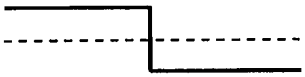
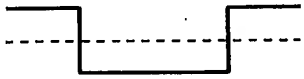
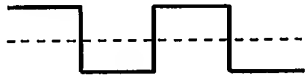
H0=(h0+h1+h2+h3)/2	
H1=(h0+h1- h2- h3)/2	
H2=(h0- h1- h2+h3)/2	
H3=(h0- h1+h2- h3)/2	

FIG. 9A

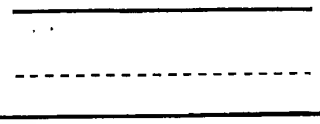
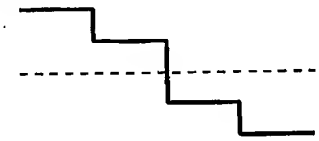
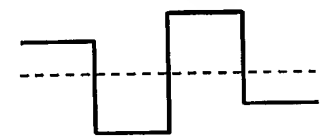
D0=(d0+d1+d2+d3)/2	
D1=(2d0+d1- d2- 2d3)/(√10)	
D2=(d0- d1- d2+d3)/2	
D3=(d0- 2d1+2d2- d3)/(√10)	

FIG. 9B

d0=(D0+D1'+D2+D3'/2)/2
d1=(D0+D1'/2- D2- D3')2
d2=(D0+D1'/2- D2+D3')2
d3=(D0- D1'+D2- D3'/2)/2
D1'=D1√8/√5
D3'=D3√8/√5

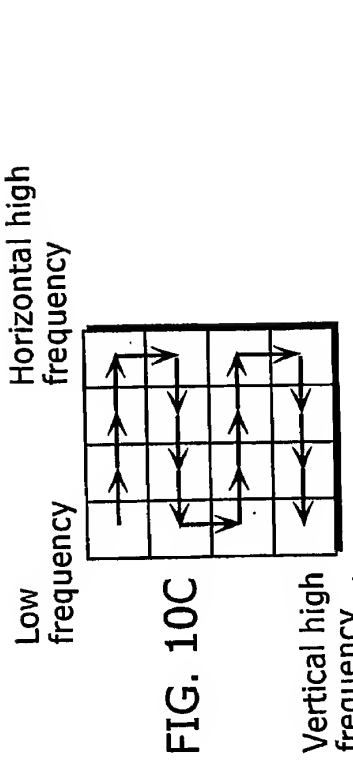


FIG. 10C

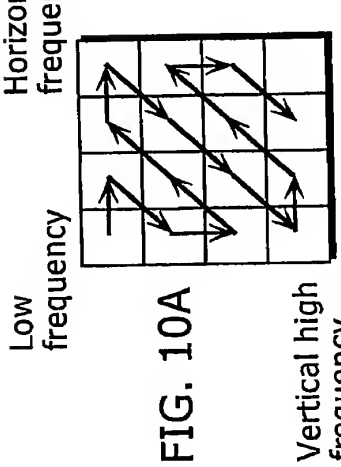


FIG. 10A

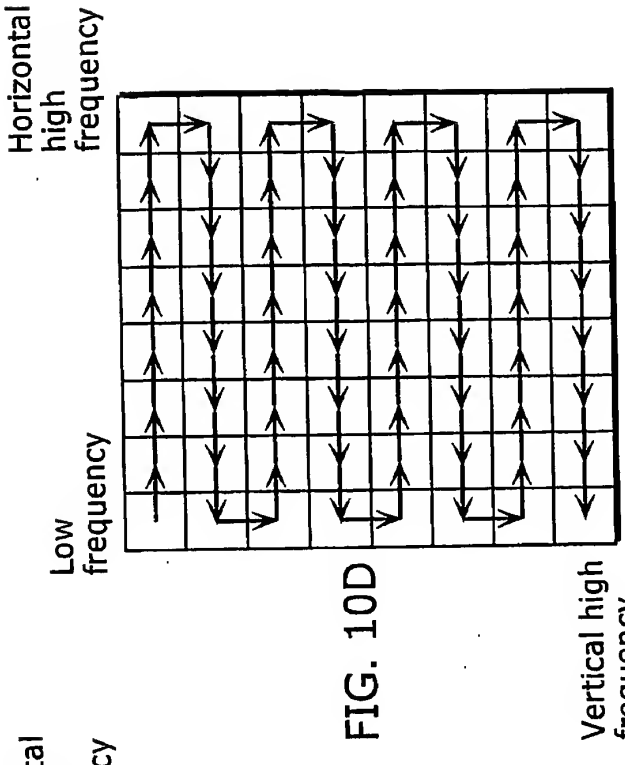


FIG. 10D

FIG. 10B

FIG. 11A

W_{00}	W_{01}	W_{02}	W_{03}	W_{04}	W_{05}	W_{06}	W_{07}
W_{10}	W_{11}	W_{12}	W_{13}	W_{14}	W_{15}	W_{16}	W_{17}
W_{20}	W_{21}	W_{22}	W_{23}	W_{24}	W_{25}	W_{26}	W_{27}
W_{30}	W_{31}	W_{32}	W_{33}	W_{34}	W_{35}	W_{36}	W_{37}
W_{40}	W_{41}	W_{42}	W_{43}	W_{44}	W_{45}	W_{46}	W_{47}
W_{50}	W_{51}	W_{52}	W_{53}	W_{54}	W_{55}	W_{56}	W_{57}
W_{60}	W_{61}	W_{62}	W_{63}	W_{64}	W_{65}	W_{66}	W_{67}
W_{70}	W_{71}	W_{72}	W_{73}	W_{74}	W_{75}	W_{76}	W_{77}

FIG. 11B

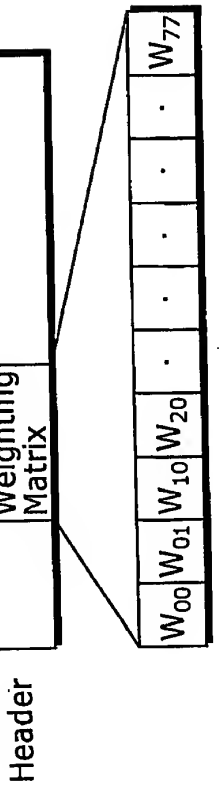


FIG. 11C

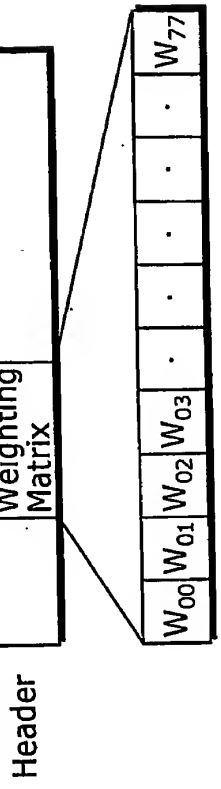


FIG. 12

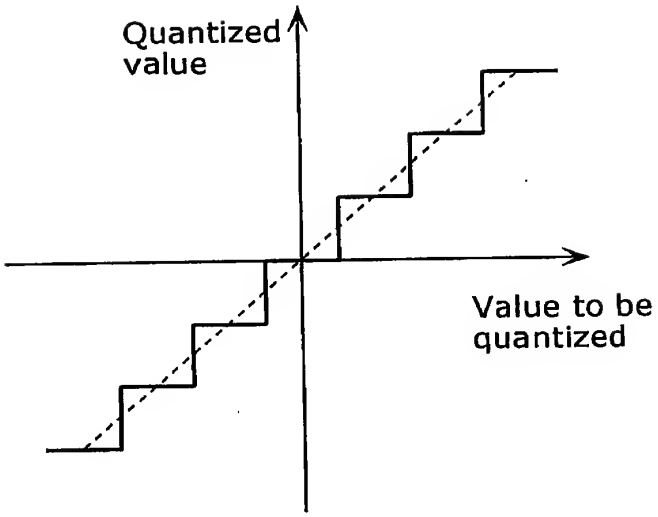


FIG. 13

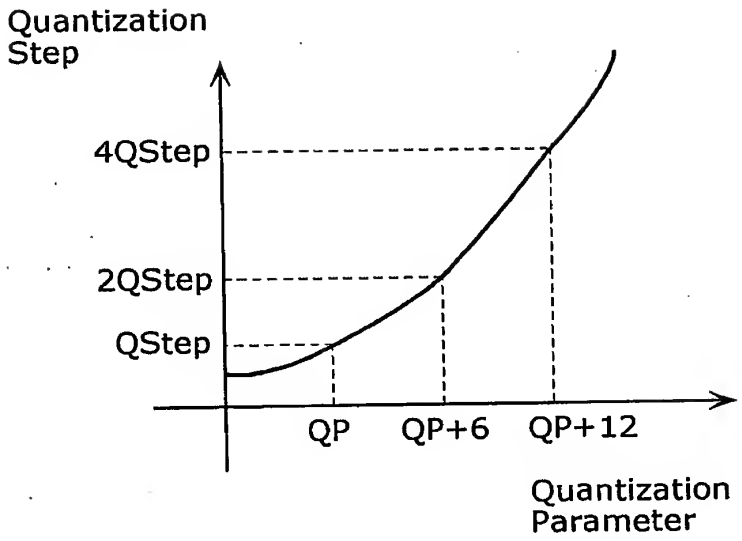

Quantization Step
4QStep
2QStep
QStep
QP
QP+6
QP+12
Quantization Parameter

FIG. 14

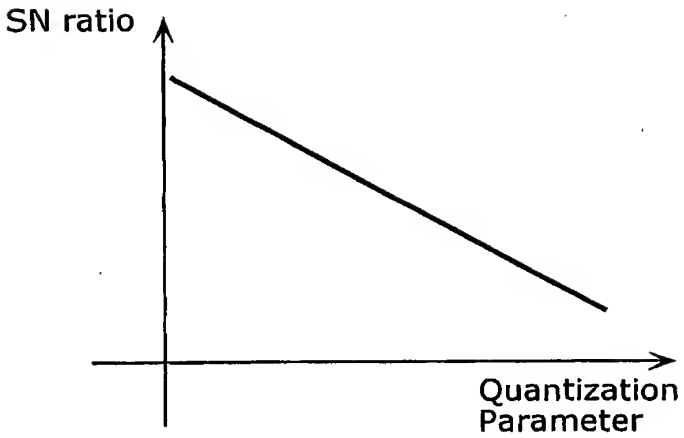


FIG. 15A

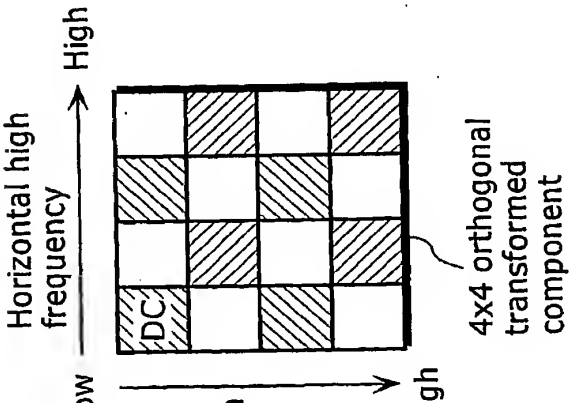


FIG. 15B

	Multiply quantization value by value obtained by multiplying value of (QP%6) in column α by $2^{QP/6}$
	Multiply quantization value by value obtained by multiplying value of (QP%6) in column β by $2^{QP/6}$
	Multiply quantization value by value obtained by multiplying value of (QP%6) in column γ by $2^{QP/6}$

FIG. 15C

QP%6	α	β	γ
0	10	16	13
1	11	18	14
2	13	20	16
3	14	23	18
4	16	25	20
5	18	29	23

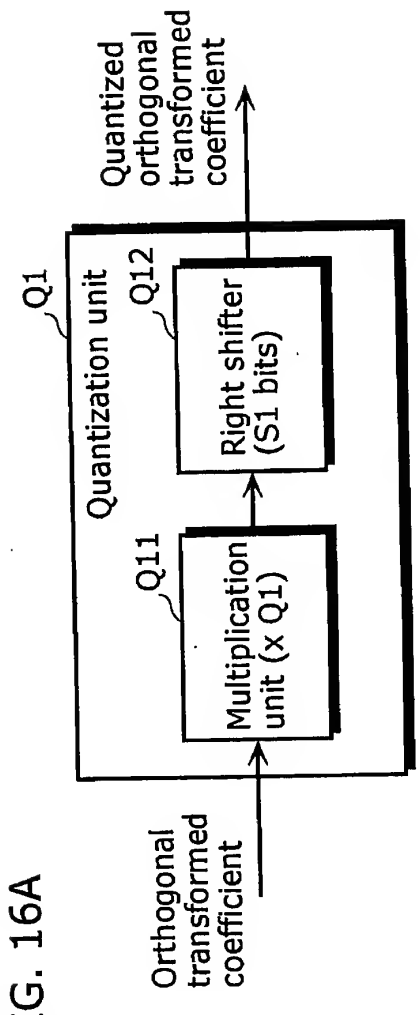


FIG. 16A

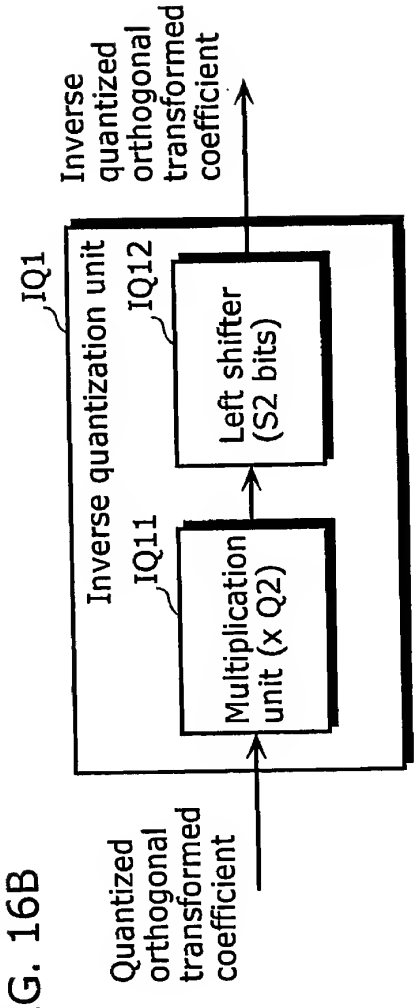


FIG. 16B

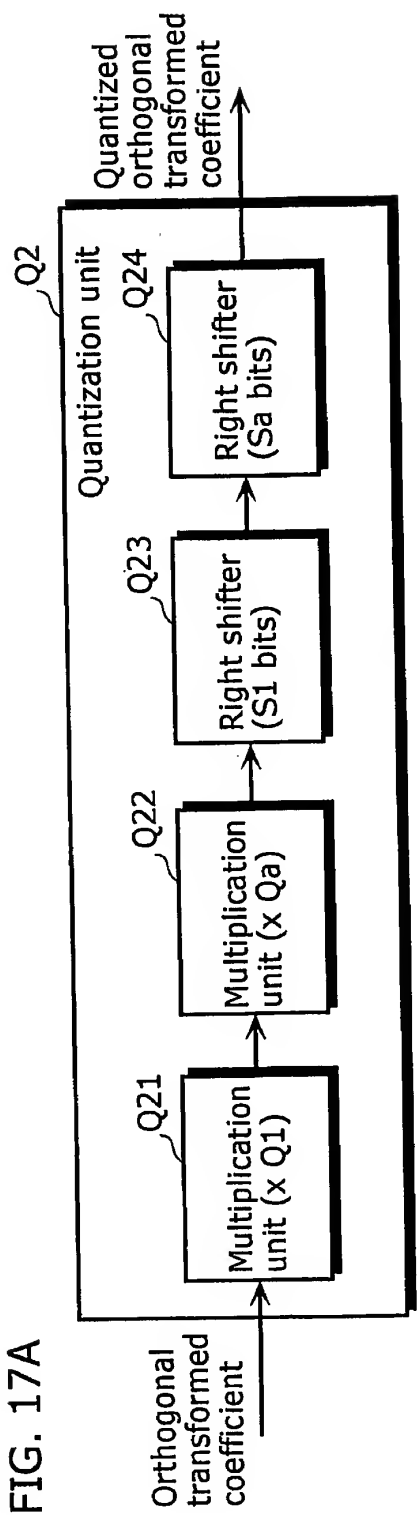


FIG. 17A

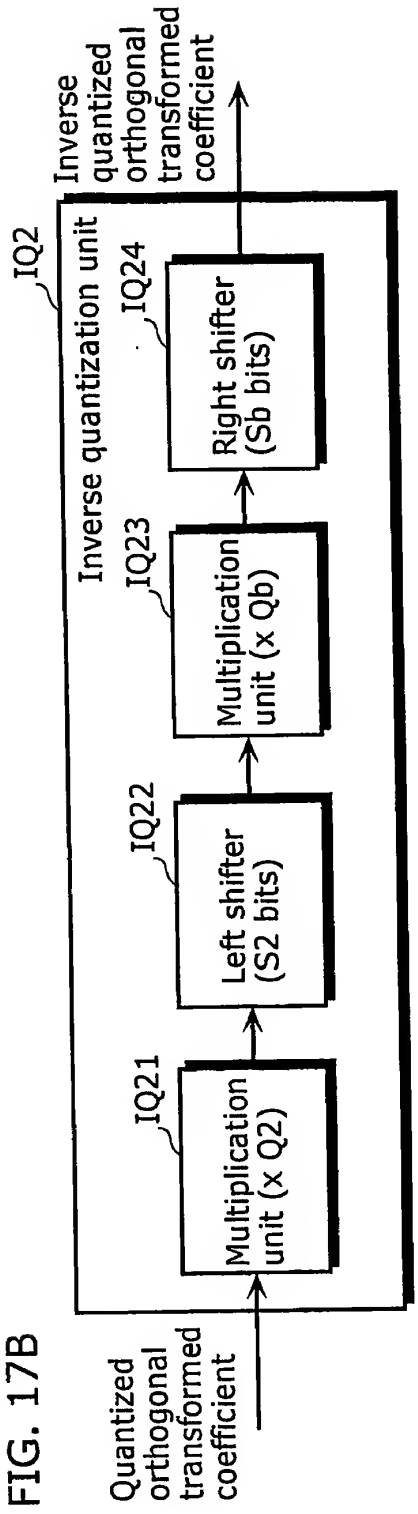


FIG. 17B

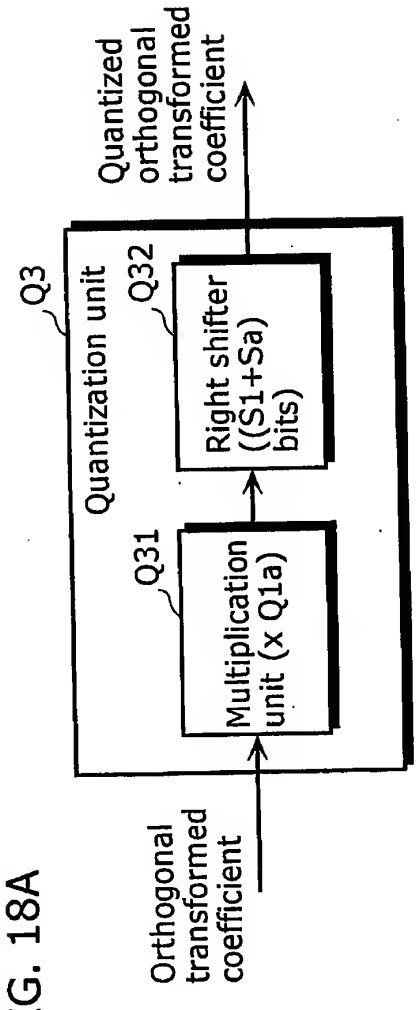


FIG. 18A

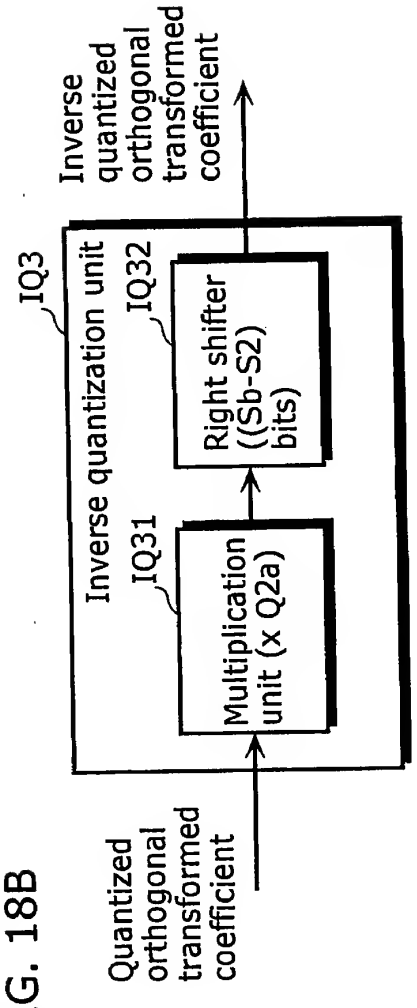


FIG. 18B

FIG. 19

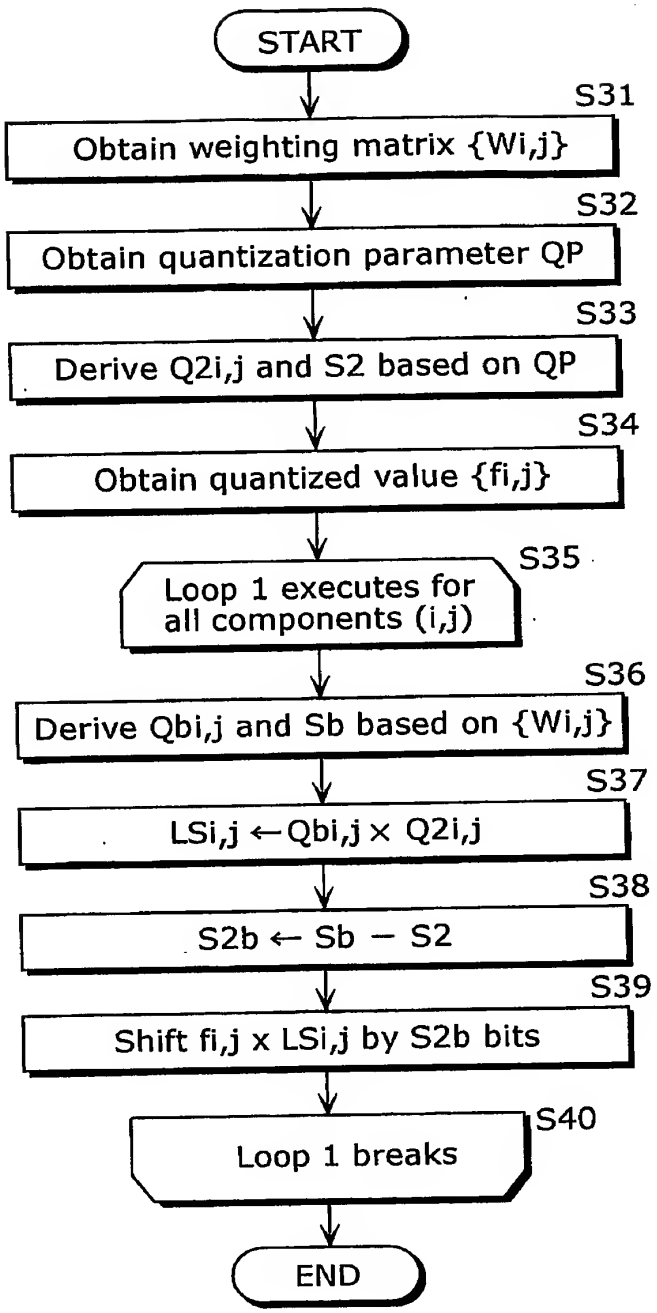
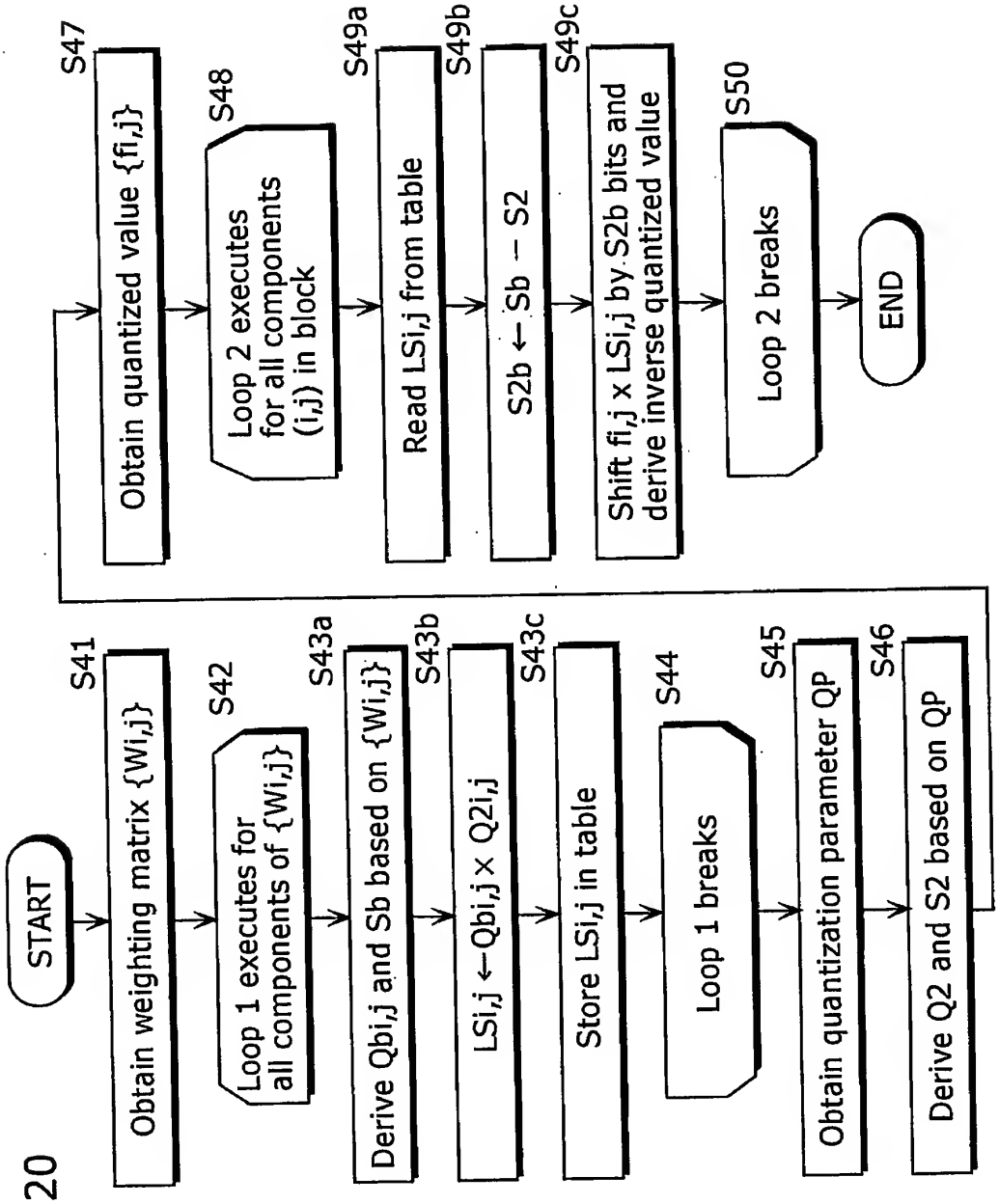

START
S31
Obtain weighting matrix {Wi,j}
S32
Obtain quantization parameter QP
S33
Derive Q2i,j and S2 based on QP
S34
Obtain quantized value {fi,j}
S35
Loop 1 executes for all components (i,j)
S36
Derive Qbi,j and Sb based on {Wi,j}
S37
LSi,j ← Qbi,j × Q2i,j
S38
S2b ← Sb − S2
S39
Shift fi,j x LSi,j by S2b bits
S40
Loop 1 breaks
END

FIG. 20


START
S41
Obtain weighting matrix {Wi,j}
S42
Loop 1 executes for all components of {Wi,j}
S43a
Derive Qbi,j and Sb based on {Wi,j}
S43b
LSi,j ← Qbi,j × Q2i,j
S43c
Store LSi,j in table
S44
Loop 1 breaks
S45
Obtain quantization parameter QP
S46
Derive Q2 and S2 based on QP
S47
Obtain quantized value {fi,j}
S48
Loop 2 executes for all components (i,j) in block
S49a
Read LSi,j from table
S49b
S2b ← Sb − S2
S49c
Shift fi,j x LSi,j by S2b bits and derive inverse quantized value
S50
Loop 2 breaks
END

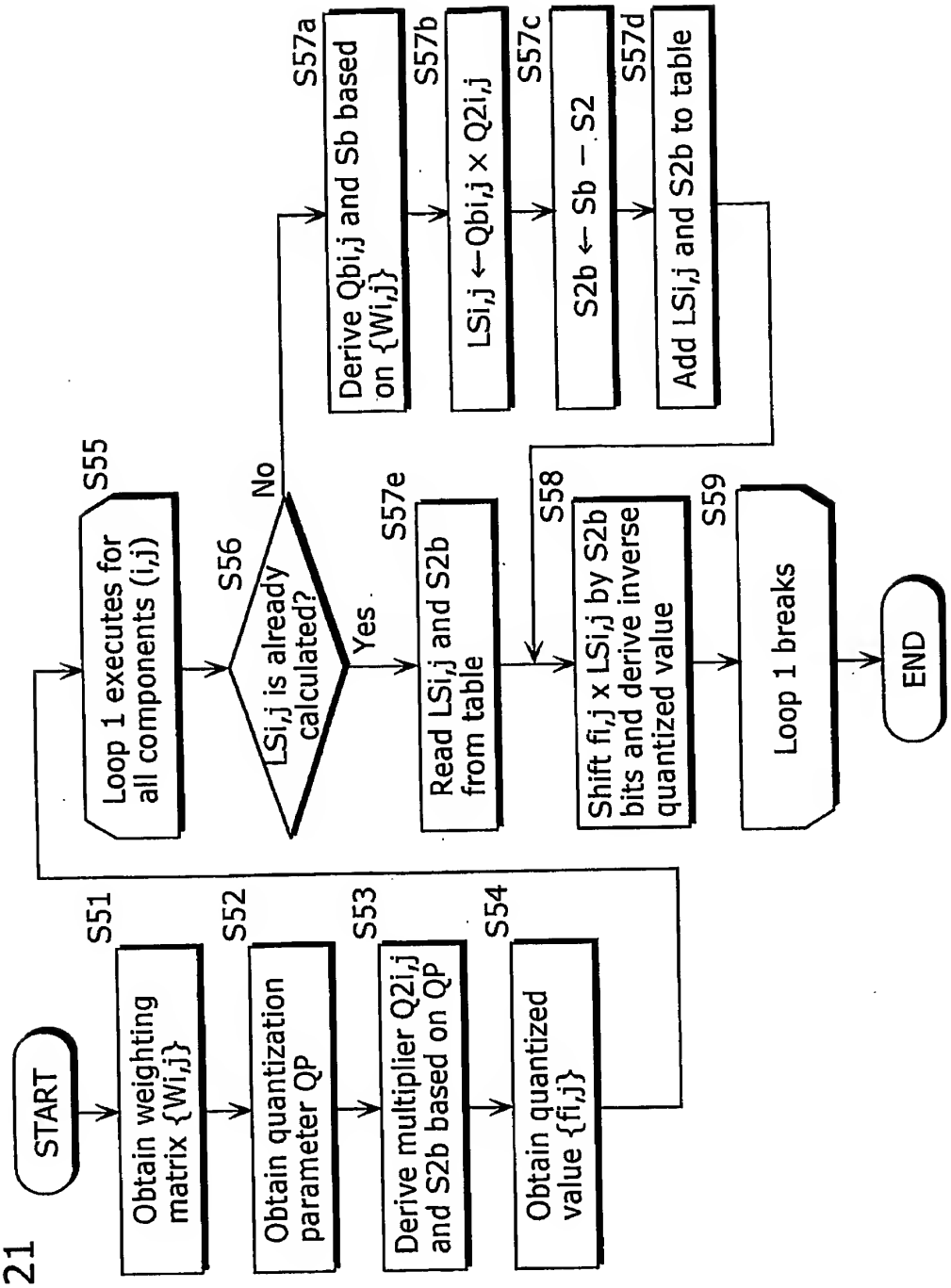

START
S51
Obtain weighting matrix {Wi,j}
S52
Obtain quantization parameter QP
S53
Derive multiplier Q2i,j and S2b based on QP
S54
Obtain quantized value {fi,j}
S55
Loop 1 executes for all components (i,j)
S56
LSi,j is already calculated?
No
Yes
S57a
Derive Qbi,j and Sb based on {Wi,j}
S57b
LSi,j ←Qbi,j × Q2i,j
S57c
S2b ← Sb − S2
S57d
Add LSi,j and S2b to table
S57e
Read LSi,j and S2b from table
S58
Shift fi,j x LSi,j by S2b bits and derive inverse quantized value
S59
Loop 1 breaks
END

FIG. 21

FIG. 22

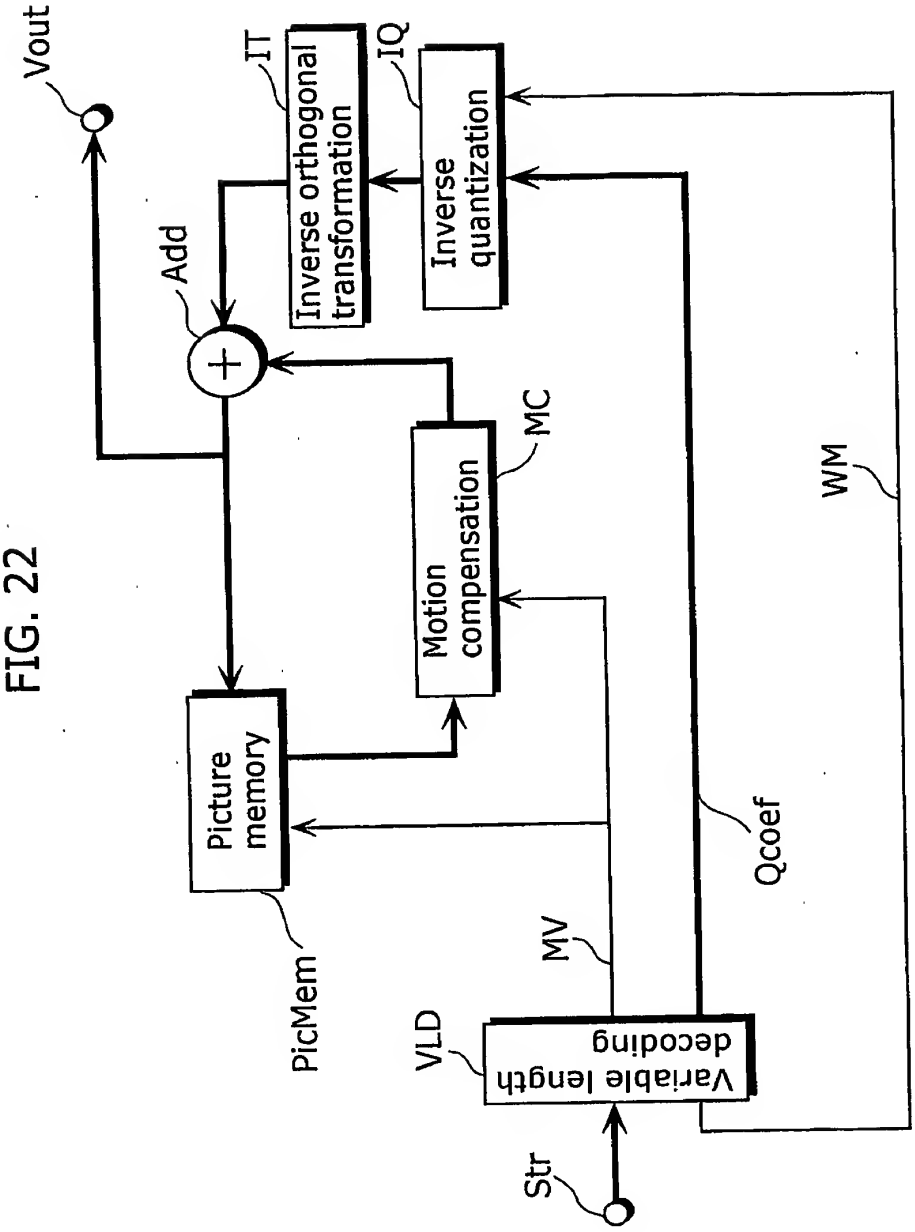

Vout
IT
IQ
Inverse orthogonal transformation
Inverse quantization
Add
MC
Motion compensation
WM
Picture memory
Qcoef
MV
PicMem
VLD
Variable length decoding
Str

FIG. 23A

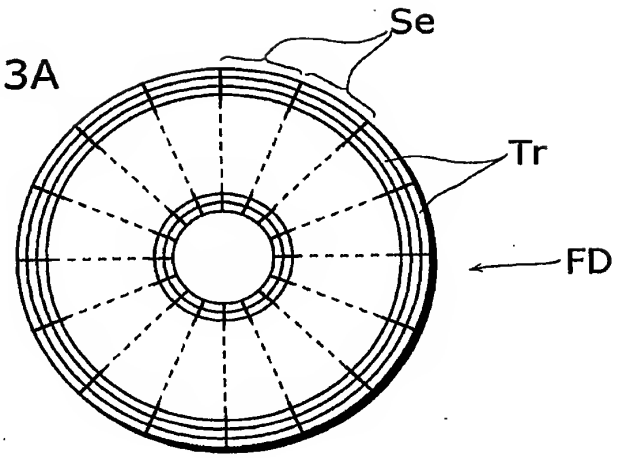


FIG. 23B

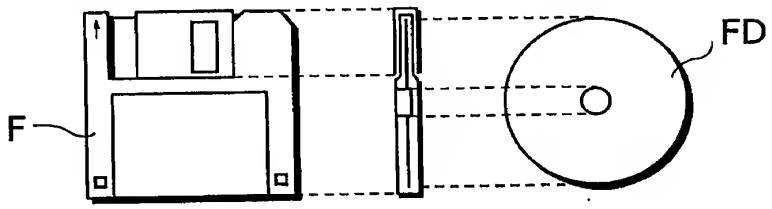
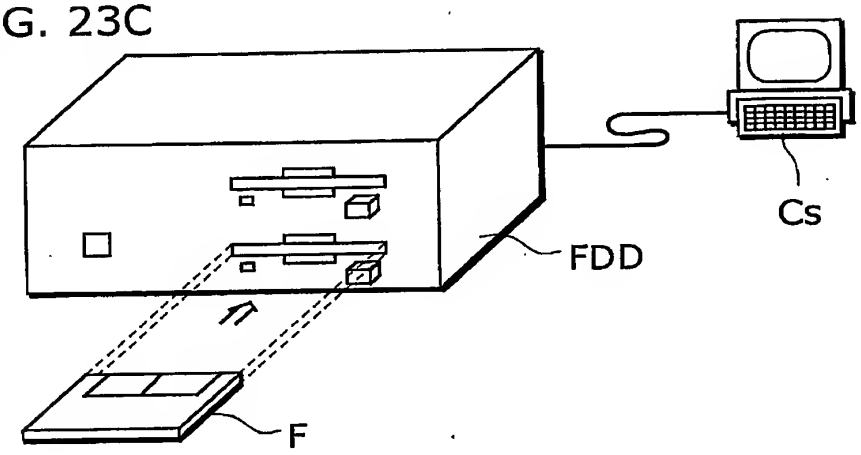


FIG. 23C



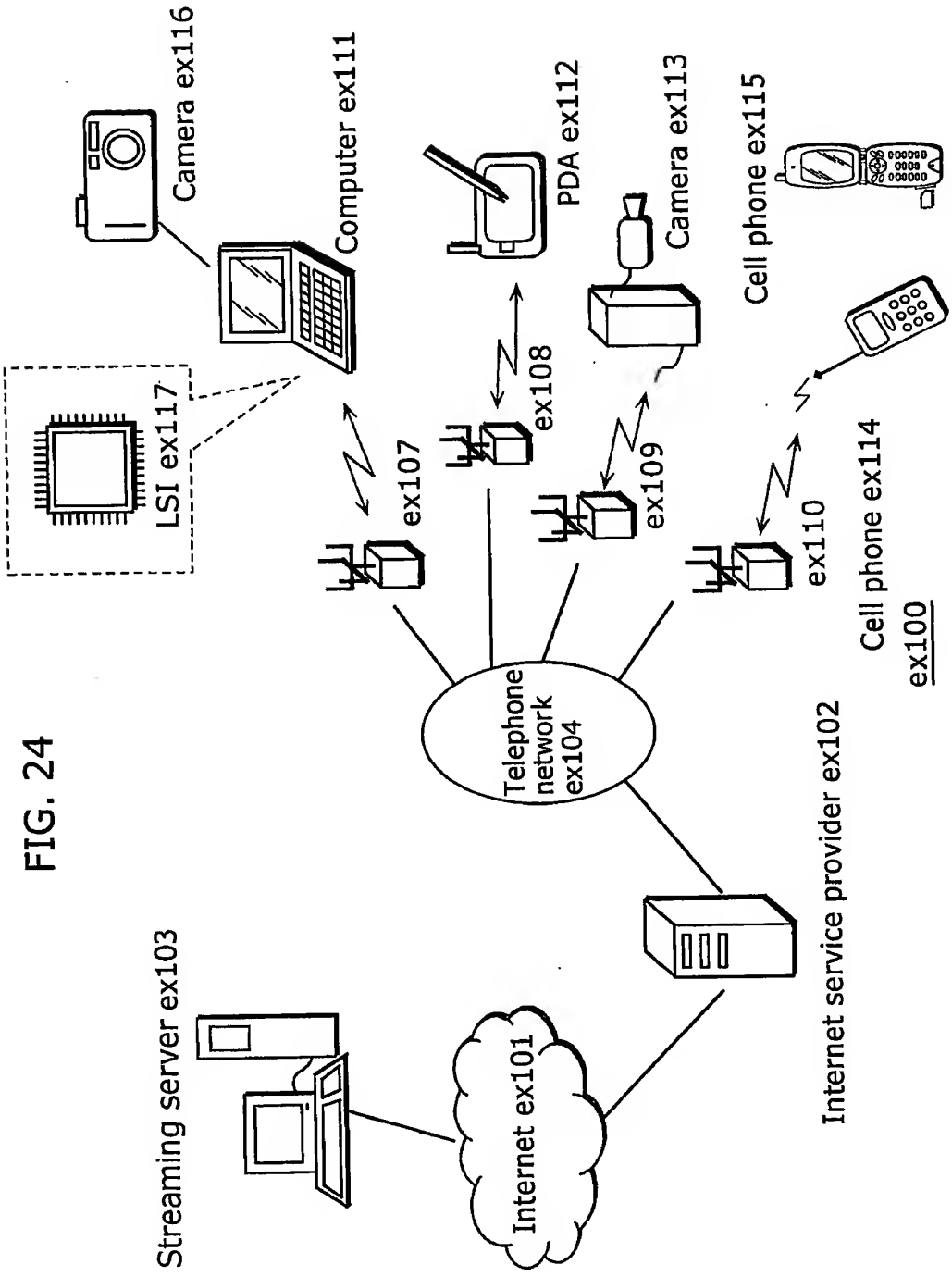

Camera ex116
Computer ex111
PDA ex112
Camera ex113
Cell phone ex115
LSI ex117
ex107
ex108
ex109
ex110
Cell phone ex114
ex100
Telephone network ex104
Internet service provider ex102
Streaming server ex103
Internet ex101

FIG. 24

FIG. 25

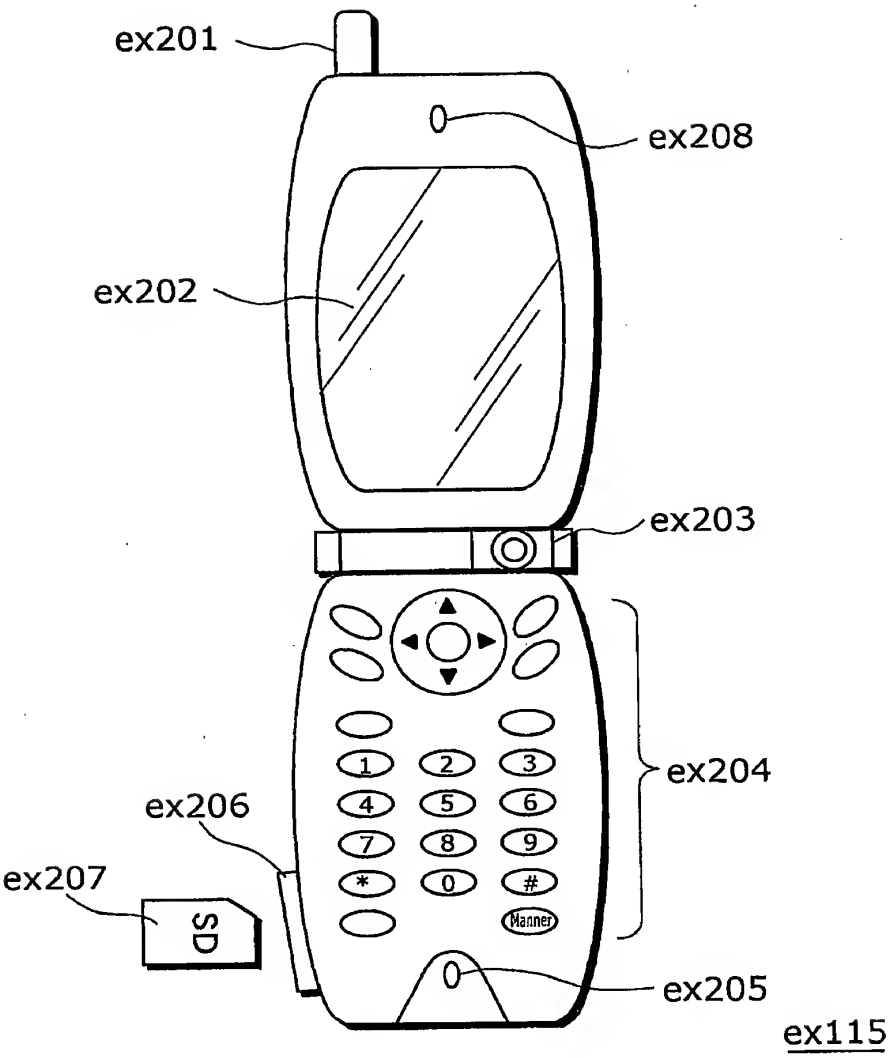

ex201
ex208
ex202
ex203
ex204
ex206
ex207
SD
ex205
ex115
1
2
3
4
5
6
7
8
9
*
0
#
Manner

FIG. 26

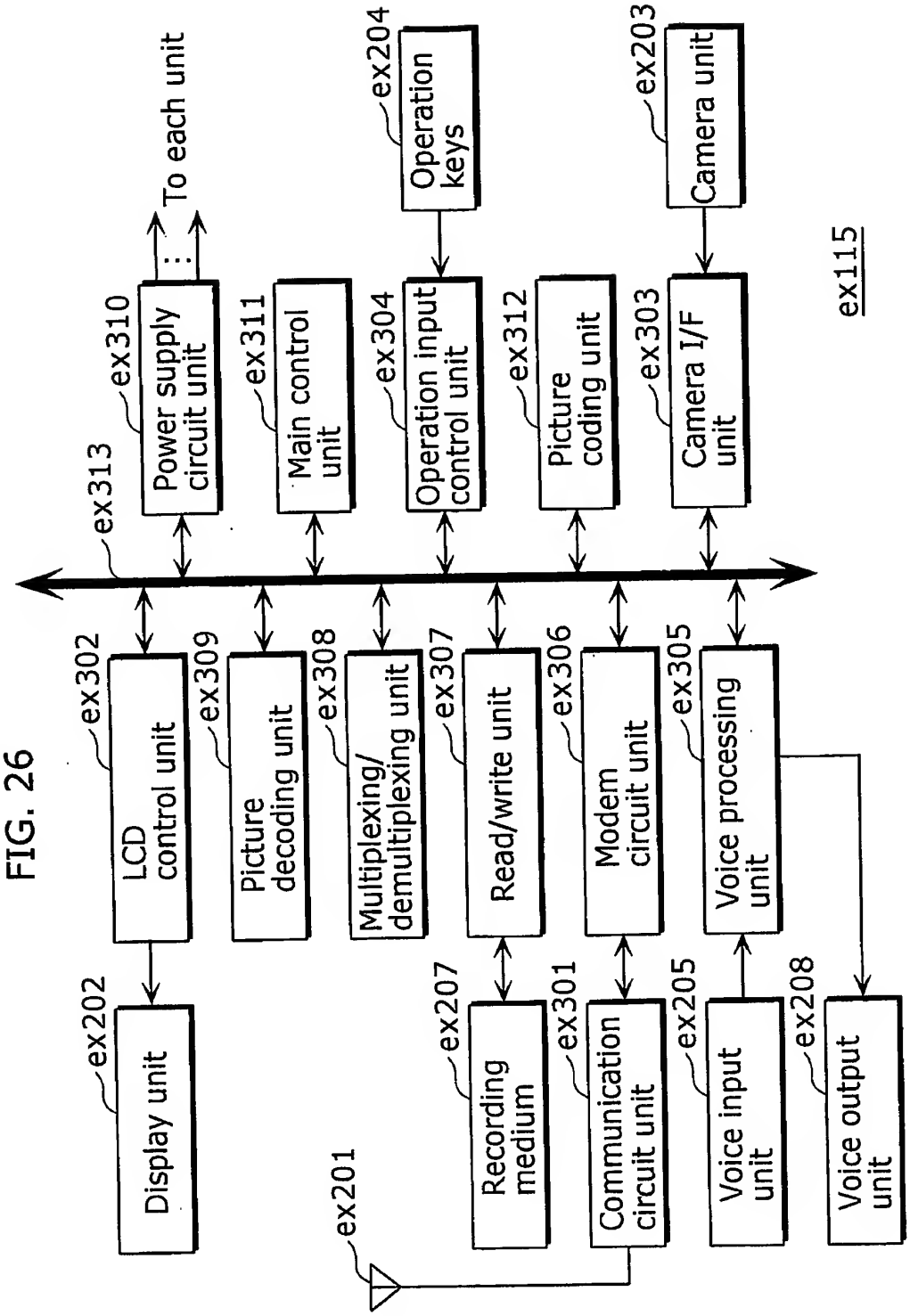

ex115
ex313
ex310
Power supply circuit unit
To each unit
ex311
Main control unit
ex304
Operation input control unit
ex204
Operation keys
ex312
Picture coding unit
ex303
Camera I/F unit
ex203
Camera unit
ex302
LCD control unit
ex309
Picture decoding unit
ex308
Multiplexing/ demultiplexing unit
ex307
Read/write unit
ex306
Modem circuit unit
ex305
Voice processing unit
ex202
Display unit
ex207
Recording medium
ex301
Communication circuit unit
ex205
Voice input unit
ex208
Voice output unit
ex201

FIG. 27

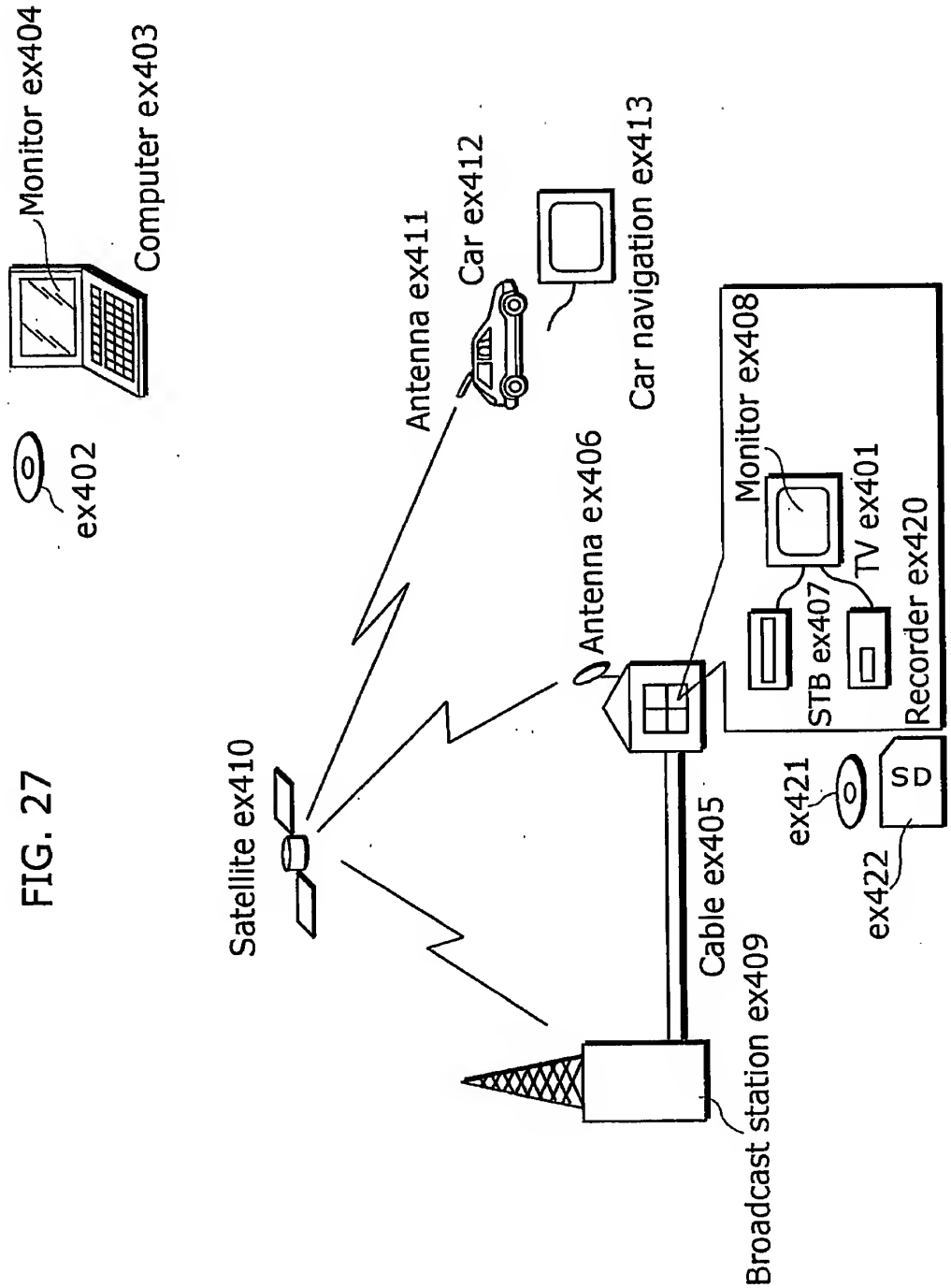

Monitor ex404
Computer ex403
ex402
Antenna ex411
Car ex412
Car navigation ex413
Antenna ex406
Monitor ex408
TV ex401
STB ex407
Recorder ex420
Satellite ex410
Cable ex405
ex421
SD
ex422
Broadcast station ex409

Fig.28

16,16,19,22,26,27.29,34
16,16,22,24,27,29,34,37
19,22,26,27,29.34,34,38
21,22,26,27,29,34,37,40
22,26,27,29,32,35,40,48
26.27,29,32,35,40,48,58
26,27,29,34,38,46,56,69
27,29,35,38,46,56,69.83

Fig.29

$$W=\begin{bmatrix}2506\\2211\\1979\\1709\\1566\\1392\end{bmatrix} \qquad V=\begin{bmatrix}15\\17\\19\\22\\24\\27\end{bmatrix}$$

Fig.30

Quantization matrix Qq (corresponding to Q1a at the encoder):

506624, 506624, 426631, 368454, 311769, 300222, 279517, 238411
506624, 506624, 368454, 337749, 300222, 279517, 238411, 219081
426631, 368454, 311769, 300222, 279517, 238411, 238411, 213315
368454, 368454, 311769, 300222, 279517, 238411, 219081, 202650
368454, 311769, 300222, 279517, 253312, 731600, 202650, 168875
311769, 300222. 279517, 253312, 231600. 202650, 168875, 139758
311769, 300222, 279517, 238411, 213315, 176217, 144750, 117478
300222, 279517, 231600, 213315, 176217, 144750, 117478, 97662

Fig.31

De-quantization matrix Qd (corresponding to Q2b at both the encoder and decoder):

4864, 4864, 5776, 6688, 7904, 8208, 8816, 10336
4864, 4864, 6688, 7296, 8208, 8816, 10336, 11248
5776, 6688, 7904, 8208, 8816, 10336, 10336, 11552
6688, 6688, 7904, 8208, 8816, 10336, 11248, 12160
6688, 7904, 8208, 8816, 9728, 10640, 12160, 14592
7904, 8208, 8816, 9728, 10640, 12160, 14592, 17632
7904, 8208, 8816, 10336, 11552, 13984, 17024, 20976
8208, 8816, 10640, 11552, 13984, 17024, 20976, 25232

Fig.32

16,19,26,29
19,26,29,34
22,27,32,40
26,29,38,56

Fig.33

$$W=\begin{bmatrix} 13107 & 5243 & 8066 \\ 11916 & 4660 & 7490 \\ 10082 & 4194 & 6554 \\ 9362 & 3647 & 5825 \\ 8192 & 3355 & 5243 \\ 7282 & 2893 & 4559 \end{bmatrix} \qquad V=\begin{bmatrix} 10 & 16 & 13 \\ 11 & 18 & 14 \\ 13 & 20 & 16 \\ 14 & 23 & 18 \\ 16 & 25 & 20 \\ 18 & 29 & 23 \end{bmatrix}$$

Fig.34 Quantization matrix Qq
(corresponding to Q1a at the encoder):

2580992,	1412904,	1588303,	925696
1412904,	660716,	925696,	505254
1877085,	994266,	1290496,	671130
1032507.	592366,	706452,	306761

Fig.35 De-quantization matrix Qd
(corresponding to Q2b at both the encoder and decoder):

3328,	4864,	5408,	7424
4864,	8320,	7424,	10880
4576,	6912,	6656,	10240
6656,	9280,	9728,	17920

Fig.36

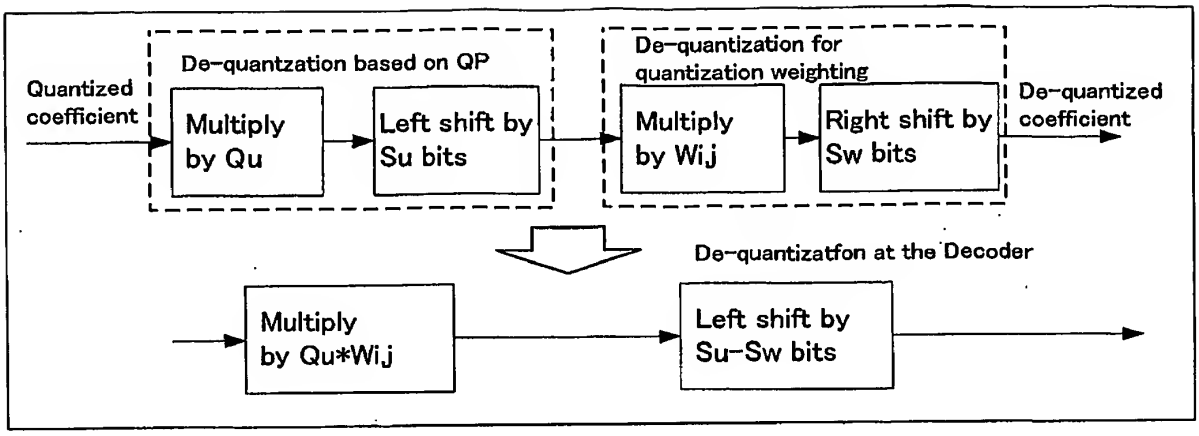


Fig.37

$$W=\begin{bmatrix} 16 & 16 & 19 & 22 & 26 & 27 & 29 & 34 \\ 16 & 16 & 22 & 24 & 27 & 29 & 34 & 37 \\ 19 & 22 & 26 & 27 & 29 & 34 & 34 & 39 \\ 22 & 22 & 26 & 28 & 30 & 35 & 37 & 41 \\ 22 & 26 & 27 & 28 & 33 & 40 & 42 & 49 \\ 26 & 27 & 30 & 32 & 35 & 40 & 48 & 59 \\ 26 & 27 & 31 & 34 & 38 & 46 & 57 & 69 \\ 26 & 29 & 36 & 39 & 45 & 55 & 68 & 78 \end{bmatrix}$$

Fig.38

$$dij = (cij * M(QP\%6,i,j)) << QP/6 - 4, \quad \text{for } QP/6 >= 4. \tag{1}$$

$$dij = (cij * M(QP\%6,i,j)) + 1 << ((3 - QP/6) >> 4 - QP/6, \quad \text{for } QP/6 < 4. \tag{2}$$

where

$$M(QP\%6,i,j) = W(i,j) * LevelScale(QP\%6,i,j) \tag{3}$$

In 8x8case, we use the definition as defined in Ref.2.

$$LevelScale(m,i,j) = \begin{bmatrix} 15 \\ 17 \\ 19 \\ 22 \\ 24 \\ 27 \end{bmatrix} \tag{4}$$

dij is used for inverse transform,where inverse transform is fully defined in Ref.2.

Fig.39

$$\text{LevelScale}(m,i,j) = \begin{cases} Vm0 \text{ for } (i,j) \in \{(0,0),(0,2),(2,0),(2,2)\}, \\ Vm1 \text{ for } (i,j) \in \{(1,1),(1,3),(3,1),(3,3)\}, \\ Vm3 \text{ otherwise;} \end{cases}$$

Fig.40

$$V = \begin{bmatrix} 10 & 16 & 13 \\ 11 & 18 & 14 \\ 13 & 20 & 16 \\ 14 & 23 & 18 \\ 16 & 25 & 20 \\ 18 & 29 & 23 \end{bmatrix}$$

Fig.41

$$\begin{bmatrix} 8 & 14 & 20 & 24 & 50 & 50 & 50 & 50 \\ 14 & 15 & 23 & 26 & 50 & 50 & 50 & 50 \\ 19 & 22 & 27 & 31 & 50 & 50 & 50 & 50 \\ 23 & 23 & 28 & 30 & 50 & 50 & 50 & 50 \\ 24 & 28 & 32 & 50 & 50 & 50 & 50 & 50 \\ 34 & 35 & 50 & 50 & 50 & 50 & 50 & 50 \\ 40 & 50 & 50 & 50 & 50 & 50 & 50 & 50 \\ 50 & 50 & 50 & 50 & 50 & 50 & 50 & 50 \end{bmatrix}$$

Fig.42

$$\begin{bmatrix} 2560 & 4256 & 8000 & 7296 & 16000 & 15200 & 20000 & 15200 \\ 4256 & 4320 & 8832 & 7488 & 15200 & 14400 & 19200 & 14400 \\ 7600 & 8448 & 13824 & 11904 & 20000 & 19200 & 25600 & 19200 \\ 6992 & 6624 & 10752 & 8640 & 15200 & 14400 & 19200 & 14400 \\ 7680 & 8512 & 12800 & 15200 & 16000 & 15200 & 20000 & 15200 \\ 10336 & 10080 & 19200 & 14400 & 15200 & 14400 & 19200 & 14400 \\ 16000 & 19200 & 25600 & 19200 & 20000 & 19200 & 25600 & 19200 \\ 2560 & 4256 & 8000 & 7296 & 16000 & 15200 & 20000 & 15200 \end{bmatrix}$$

Fig.43

$$f = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \\ 1 & -1 & 1 & -1 \end{bmatrix} \begin{bmatrix} c00 & c01 & c02 & c03 \\ c10 & c11 & c12 & c13 \\ c20 & c21 & c22 & c23 \\ c20 & c31 & c32 & c33 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \\ 1 & -1 & 1 & -1 \end{bmatrix}$$